12-Branched False Spiral Mosaic
A CC3 Tutorial by Joachim de Ravenbel[1]

Part 1 – Drawing a False Spiral

Conventions

Throughout this tutorial, I will use a colour coding to – I hope – clearly identify all the keywords:

Keyboard commands or keys will always appear in **Red**,

CC3 menu commands will always appear in ***Italic Orange***.

A **Black** name followed by an arrow point right → and, at least at the end, an ***Italic Orange*** name indicates a CC3 menu drop-down list leading to a command.

1 Many thanks to Bill Roach, aka Terraformer Author, for the nice font used for the title. You can find it here.

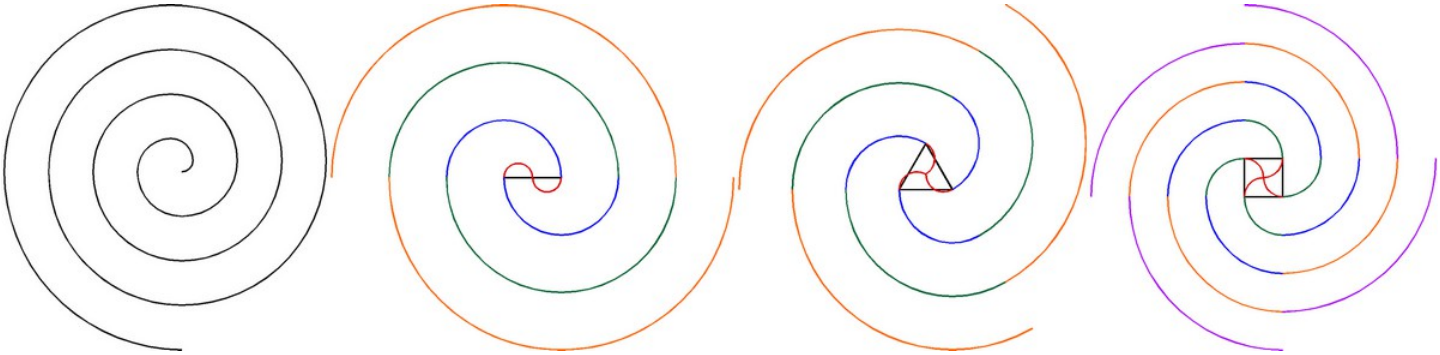
Introduction

With this tutorial you will learn to draw a spiral pattern similar to the tiling of the centre room depicted on the cover page and to apply CC3 effects to create an effective tile texture from solid coloured polygons.

The layout may look daunting but with the powerful CC3 tools and just a minimal amount of time, you will be able to create similar patterns with as many branches as you want.

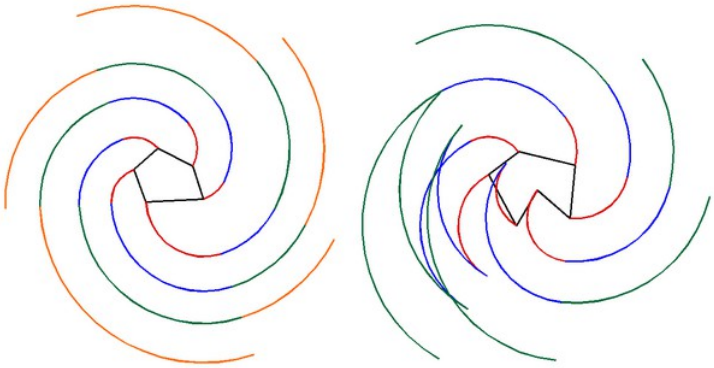
The most basic CC3 entities (lines, arcs and polygons) can be used here because the underlying shape is a *false* spiral, namely a shape made of arcs whereas a *true* spiral cannot be drawn with a compass because the distance from the centre point is ever-growing.

A false spiral is based on a regular polygon, or, in the case of a 2 branched false spiral, a line:

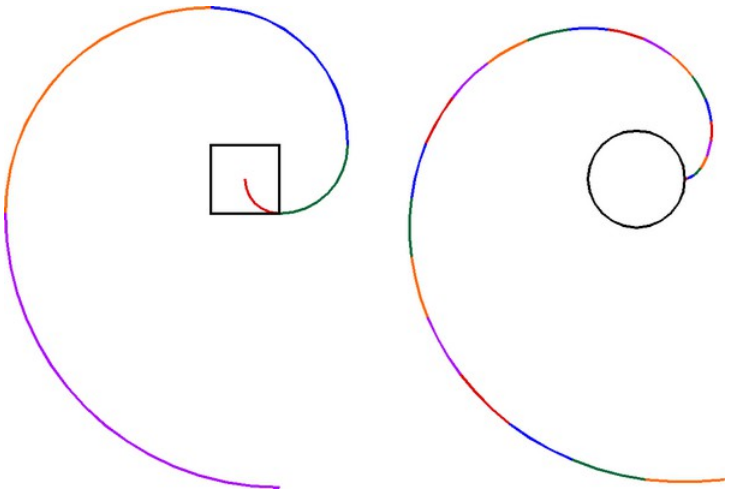


From left to right: "*true*" spiral with a linearly growing radius and deceitfully circular looking, a 2 branched false spiral, a 3 branched false spiral and a – common – 4 branched spiral. In the three later examples, the coloured entities are single arcs. See first page for an example of a 12 branched false spiral.

Note that the base polygon is not required to be regular. Using a non-regular polygon yields interesting results though a concave polygon gives very odd results.



Left: convex non-regular polygon resulting in a non even branch spacing. Right: concave polygon resulting in cross-over arcs.



And what about a single branch spiral pattern? You just choose the polygon you want and draw only one branch. The more sides the base polygon has, the closer you get to the "*true*" spiral above.

Left: single branch false spiral based on a square. Right: single branch false spiral based on a 24-sided regular polygon. Note how the polygon almost looks like a circle due to the relatively high number of sides.

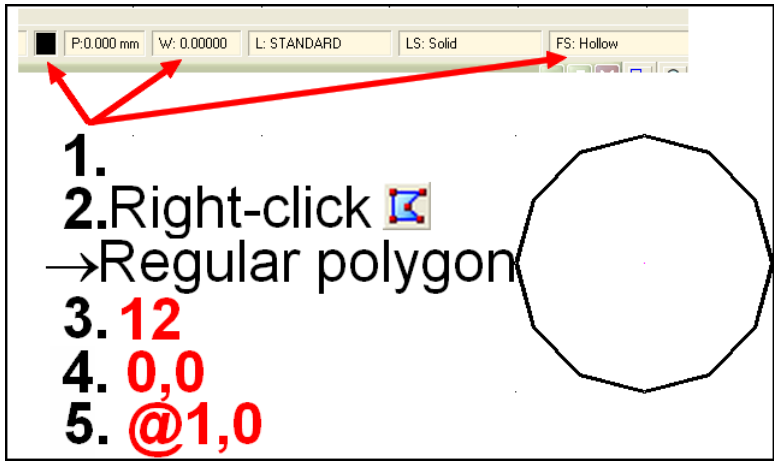
1. Drawing the core polygon

The first step is to draw the core polygon, here a regular dodecagon (12 sided polygon).

1. Start a new map. A blank map is provided here. It is quite suitable for this tutorial and you can copy/paste your work in a main map once finished. Set the line width to 0, the fill style to hollow and the colour to black (0) or any other colour you're comfortable with.
2. Right-click the ***polygon*** tool and choose ***Regular Polygon***. Alternatively type **RPOLY** on your keyboard, followed by a carriage return (henceforth designed by "↵" in this tutorial). You can follow what you type in the command line: the large box with blue text beneath CC3's main screen.
3. This command line is also used to request data input. It should now read "Number of nodes [6]". 6 is the default value to generate a regular hexagon. CC3 however stores the last input so if you used the command previously in this session, you might see another number.
   For now, just type **12**↵ or specify another number if you already want to adapt to a particular project.
4. The command line now reads "Center [0.00000,0.00000]:" and the cross-hair cursor appears. It means you have at least 3 options:
   - click anywhere on the screen to choose the centre of the polygon
   - specify the centre coordinates by typing them on the keyboard
   - right-click to accept the default value. Again, if you used the command previously in this session, the default might not be [0.00000,0.0000].

   Type **0,0**↵ or use any other option to specify the centre. More options include using a *modifier* and this will be addressed later in this tutorial (pages 6-7).
5. The command line lastly reads "1st corner:" and what is called a *dynamic cursor* appears. You should see a 12 sided polygon whose centre doesn't move but whose size and angle varies as you move your mouse. Here you have again three main options:
   - click anywhere on the screen when the polygon looks nice
   - type the absolute coordinates of the first node
   - type the relative coordinates of the first node

   Choosing the last option, type "**@1,0**↵" meaning one CC3 units right to the last specified point: the centre of the polygon (see next page for the control of size). The "@" character stands for "relative to last point".



Controlling the branch spacing

The distance between two consecutive branches is equal, with this method, to the side of the core polygon. You have two ways to control this distance:

- compute the radius of the polygon using the formula $radius = \frac{branch\ spacing}{2 \times \sin(180° \div N)}$

  where *N* is the number of sides/branches.

  For example, with a common spacing of 5' and 12 sides, the radius would be:

  $\frac{5'}{2 \times \sin(15°)} \simeq 9.65926'$ instead of typing "**@1,0↵**" at step **5.** you type "**@9.65926,0↵**"

  You don't even need a calculator because CC3 has a macro command: GSIN, to get the sine of an angle. The command is only available through the keyboard so you'll need to type:

  GSIN↵

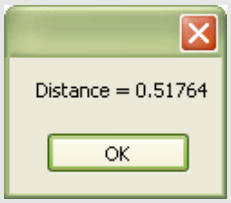
  s↵

  15°↵

  This stores the value of sin(15°) in a variable called "s".

  Now instead of typing "**@1,0↵**" at step **5.** you type "**@5/2/s,0↵**"

- the alternative is to scale the pattern up once finished. To do this, you need to get the length of the side of the polygon using the **Info**→***Distance*** combined with twice the ***Endpoint*** modifier* (or **F5** key). With the example from page 3 you'll see the pop-up bellow:

  The scale to use will then be $\frac{branch\ spacing}{polygon\ side}$

  With a 5' spacing and the 12 sided polygon from page 3 we get

  $scale = \frac{5'}{0{,}51764} \simeq 9.65922'$ which is unsurprisingly close to the value computed above using the sine.

  Instead of using a calculator, you can also rely on CC3 to do almost all the work for you with the macro command GDIST to get a distance. Type:

  GDIST↵

  d↵

  then use the ***Endpoint*** modifier* (**F5**) to specify two consecutive nodes of the polygon.

  This stores the distance in a variable called "d".

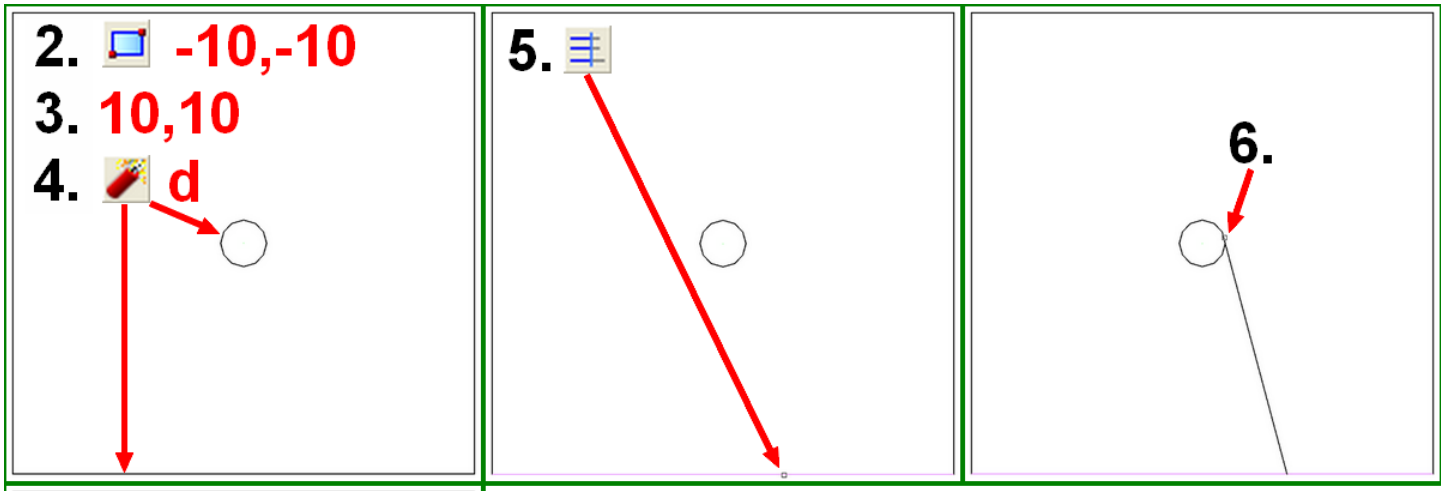
  When you need to put the scale factor in, just type **5/d↵**.

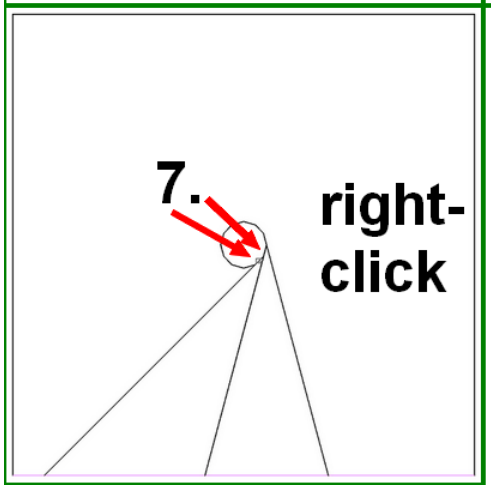
* see pages 6-7 for a detailed example using this modifier.

2. Limiting the area and extending half lines

Limiting the drawing area is in no way definitive and expanding or reducing this area will be very easy once the spiral is started. It will however allow quick trimming of construction lines:

1. You can limit the area by adding a greater polygon with the same number of sides as the core polygon, or by adding a square using the ***Box*** tool.
2. This tutorial uses the square option so click (or type **BOX↵**). The command line reads "1st corner:" and the cross-hair cursor appears. Type **-10,-10↵** to create a 20×20 box centred on the polygon, use another size, or just click on the screen to specify the first corner.
3. The command line now reads "Opposite corner:". Type **10,10↵**, adapt or click. If the box doesn't show or only shows partially, use ***Zoom Extends*** (**ZEXT↵**)
4. To modify each side of the core polygon, ***Explode*** it (**EXPLODE↵**). Click on the icon and as we will also explode the limiting shape, click on the core polygon and on the limiting shape then right-click and choose **do it** (alternatively type "**d**" without right-clicking).
5. Now we need to lengthen each of the core polygon sides. Use ***Trim to entity*** (**TRIMTO↵**) and when the command line reads "Select entity to trim to:" click on the bottom side of the limiting polygon.
6. The command line reads "Select entity to trim:" so click on a side to the right of the core polygon that is bound to extent to the bottom line of the limiting polygon.
7. Continue following a clockwise progression then right-click to end the command when it looks like the next side of the core polygon should trim to the left side of limiting polygon.

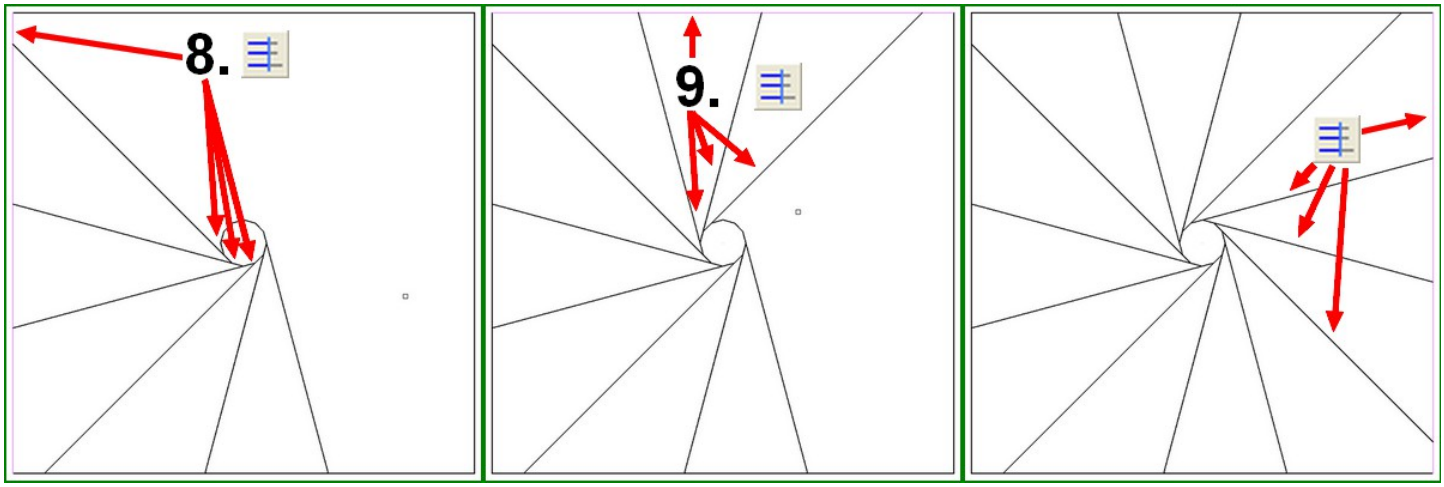




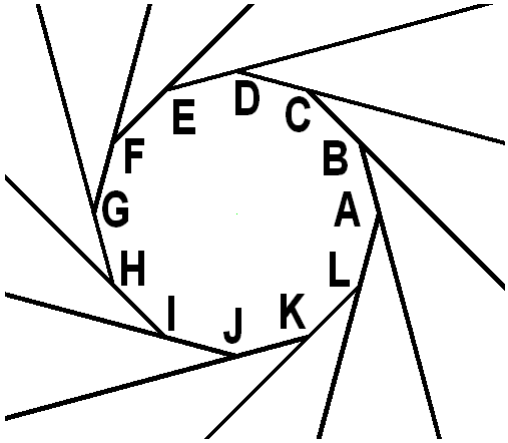
Notes:

- The pink colour denotes selected entities.
- Making the half lines rotate clockwise is forced by the way CC3 handles arcs (counter-clockwise). If you wish to turn the other way, it's best to use the ***Mirror*** command (right-click ***Move***) once the spiral is completed.

8. Left-click anywhere in the drawing area to launch the ***Trim to entity*** command again (alternatively, right-click and choose **Repeat last command**, or left-click on the icon: or use the keyboard command: **TRIMTO**↵). Select the next clockwise side of the limiting polygon (here left) and resume trimming in the clockwise order.
9. Repeat with all the sides of the limiting polygon.
10. Save your work!



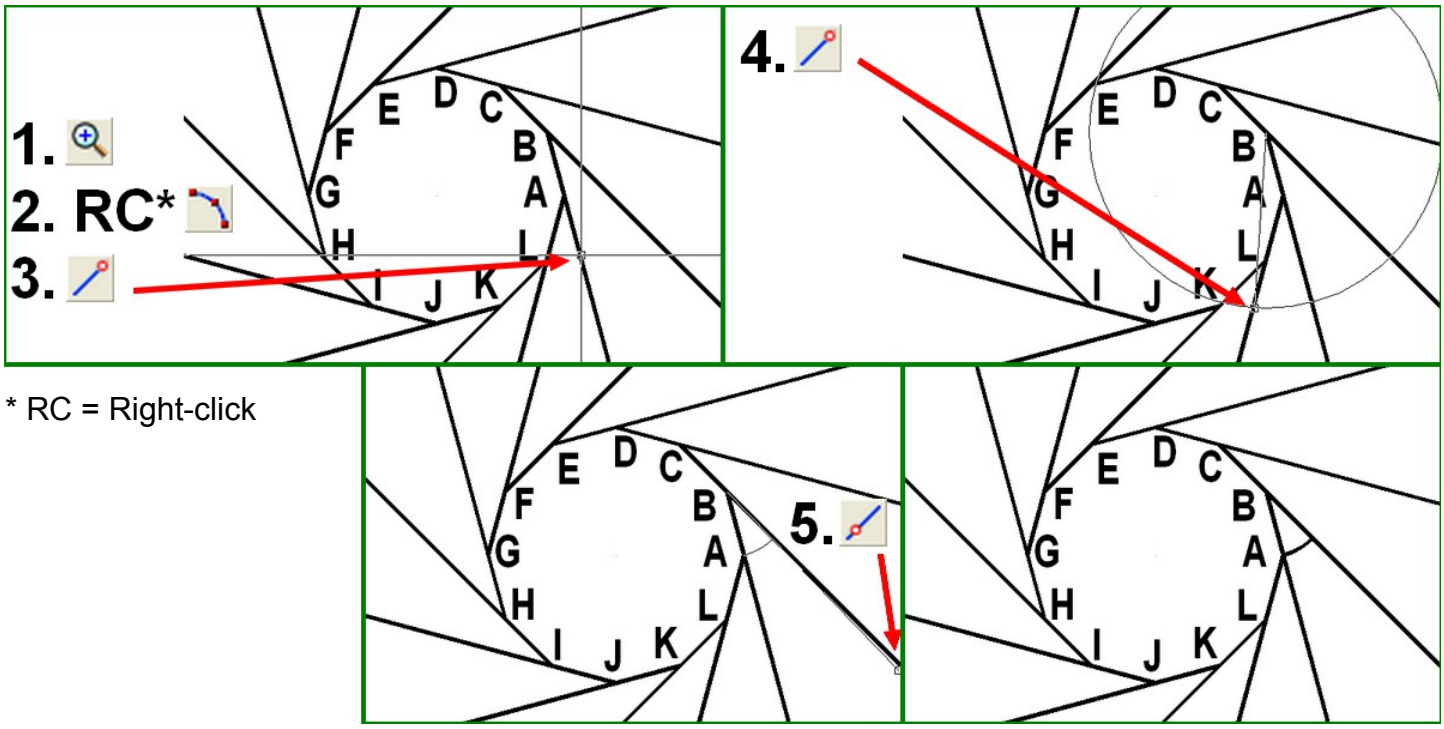
3. Drawing the first branch



False spirals are made of circle arcs so the first branch will be built as we would do with a compass: fastening the spike on one node (vertex) of the core polygon, extending the pencil to the next clockwise node and rotating counter-clockwise to the first half line.
The CC3 equivalent is the ***Center, start and end*** command available by right-clicking the ***Arc*** icon: .

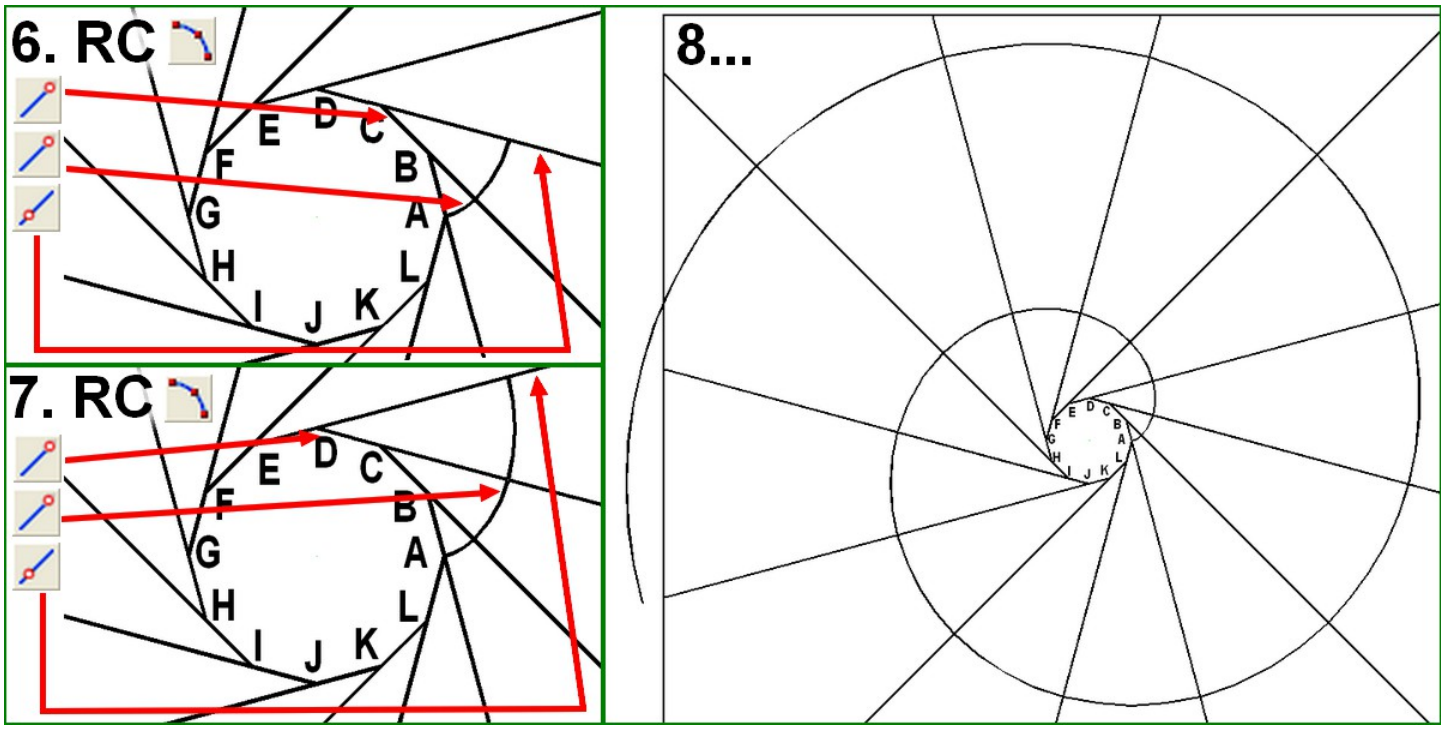
For clarity's sake, all the nodes have been marked in counter-clockwise alphabetical order.

1. ***Zoom in*** on the core polygon with some space around it.
2. Right-click the ***Arc*** icon: and choose ***Center, start and end***. Alternatively launch the command by typing **ARCS**↵.
3. The command line reads: "Center[number,number]:". To precisely select point B, click on the ***Endpoint*** modifier or hit the **F5** function key of your keyboard. The command line turns to "Entity:". Carefully select the half-line starting at B and going through A, anywhere on the **half part nearest to B**.
4. The cross-hair cursor turns in a circle dynamic cursor centred on B and the command line now reads "[Dyn Track] Starting Point:". Select point A with the ***Endpoint*** modifier (**F5**), clicking on the half-line starting at point A going through point L.
5. The cursor is now a dynamic arc with a fixed radius (the distance from A to B: the length of the side of the core polygon) and the command line shows "[Dyn Track] Ending Angle". This arc must end on the half line starting at C and going through B so click the ***On*** modifier (**F9**) and click anywhere on this half line, moving counter-clockwise with your mouse.



* RC = Right-click

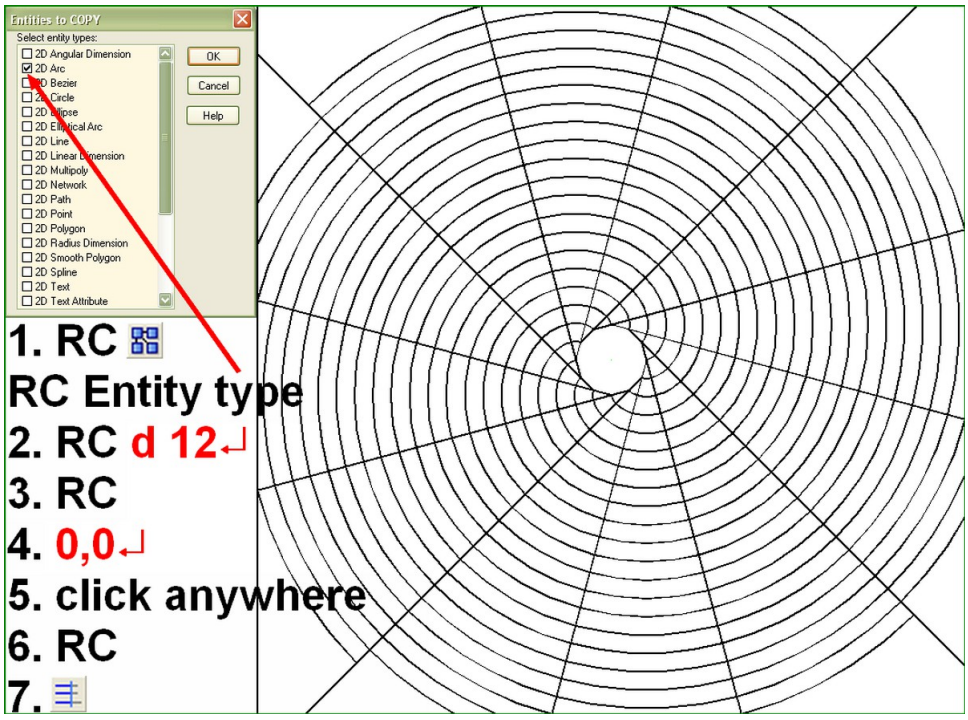
6. Left-click on the drawing area to repeat the last command (alternatively, right-click and choose **Repeat last command**, or right-click on the icon: and choose ***Center, start and end*** or use the keyboard command: **ARCS**↵). Now select point C as the centre and the second endpoint of the new arc (the first endpoint being point A) as the starting point (both with the ***Endpoint*** modifier or **F5**) and place the ending angle on the half line starting at D going through C (use the ***On*** modifier or **F9**).
7. Repeat step **6.** with point D as the centre, the last endpoint of the newest arc as the starting point, ending on the half line starting at E going through D.
8. Continue likewise, turning counter-clockwise around the core polygon until you cross the limiting polygon (***Zoom out*** when necessary).



4. Copying the first branch

With CC3's ***Circular Array*** command and powerful selection tools, it's very easy to duplicate the first branch.
Note: to turn the spiral into a mosaic like the example on the cover page, don't follow this step now.

1. Right-click on the ***Copy*** icon and choose ***Circular Array*** or just type **CARY↵**. The command line reads "Select entities (0 picked):". Right-click and choose **Entity type**. Check the **2D Arcs** check-box (second from top) then click the **OK** button. The first branch should be selected.
2. Right-click and choose **do it** or just type "**d**". The command line reads "Number of spokes [1]:" so type **12↵** or the desired number of branches if you want more or less.
3. Now you see "Number of rings [1]:" in the command line. Type **1↵** or just right-click to accept this default value.
4. At the "Array center [number,number]:" prompt either type **0,0↵**, or right-click if the default value is the centre of the core polygon, or type the coordinates of your chosen centre.
5. The "Origin of the array:" has no utility so just click anywhere on the drawing area.
6. The last prompt is "Angle between spokes[30°]:". This default value is calculated from your "Number of spokes" input. It's just 360° divided by this number to represent an even spacing. Usually, you just have to right-click in order to complete the command. Otherwise, specify the angle between spokes.
7. ***Trim to entity*** (**TRIMTO↵**) the overlapping arcs. This command is sometimes tricky with arcs: often you need to select the part to erase instead of the usual way to select the part to keep. Only experience and the use of the **Edit→*Undo*** command (**Ctrl + Z**) will tell...



Conclusion:

This 5 steps method allow you to create false spirals with any number of branches:

1. Create the core regular polygon
2. Create the limiting polygon
3. Explode both polygons and trim the sides of the first to the sides of the second
4. Draw arcs
5. Duplicate the single branch with the ***Circular array*** command.